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Arthonia, *Byssoloma*, *Calenia*, *Chroodiscus*, *Coenogonium*, *Eremothecella*, and *Semigyalecta spp.* new to China

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Abstract—Ten foliicolous lichens are newly reported for China—*Arthonia accolens*, *A. cyanea*, *A. palmulacea*, *Byssoloma annuum*, *B. subleucoblepharum*, *Calenia lueckingii*, *Chroodiscus argillaceus*, *Coenogonium minimum*, *Eremothecella macrosperma,* and *Semigyalecta paradoxa*. Except for *C. minimum* collected from Guangxi Province, these species were collected from a rain forest in Hainan Province. Descriptions and photos of the ten species and comments are provided.

Key words—Asia, *Gomphillaceae*, *Graphidaceae*, *Gyalectaceae*, *Pilocarpaceae*

Introduction

Foliicolous lichens are mainly crustose lichens inhabiting the surface of living leaves of plants. More than 800 species are presently known in the world, which are found primarily in tropical and subtropical regions (Lücking 2008). Foliicolous lichens are common in south China, mainly in the provinces of Hainan, Yunnan, Guangxi, and Guangdong, as well as in Taiwan. Although foliicolous lichen diversity is rather rich in these regions, it lacks detailed study; in fact, only a few articles have been published on the foliicolous lichens of China (Sérusiaux 1976, Wei & Jiang 1991, Aptroot & al. 2003, Jiang & al. 2016). Here we present the results of a study of specimens collected from Hainan and Guangxi Provinces by various collectors. All the specimens are stored at HMAS-L. *Arthonia*, *Byssoloma*, and *Coenogonium* were found to be the most

common genera and deserve particular attention. Here, we present ten new records based on our research on foliicolous lichens of China.

Materials & methods

Specimens were collected from Hainan Province by Jiang Yu-Mei & Guo Shou-Yu in 1993; Huang Man-Rong in 2000; Wei Jiang-Chun in 2000, 2006, 2007; Zhang Tao in 2007; Wei Xin-Li & Jiang Shu-Hua in 2014; and Wang Wei-Cheng in 2017 and from Guangxi Province by Jiang Shu-Hua in 2014. They are preserved in the herbarium of Institute of Microbiology, Chinese Academy of Sciences, Beijing, China (HMAS-L). Morphology and anatomy were examined under a Motic stereomicroscope and a Zeiss Axioskop 2 plus microscope. Morphological photographs were taken with a Leica M125 dissecting microscope equipped with a Leica DFC450 camera, and anatomical photographs were taken with a Zeiss Imager A2 compound microscope equipped with a Zeiss AxioCam MRc5 Camera.

Taxonomy

Arthoniaceae Rchb.

Arthonia accolens Stirt.,
Proc. Roy. Philos. Soc. Glasgow 11: 105 (1879) Fig. 1a, b

Thallus dispersed into round patches, but usually connected together in the central part, yellow-brown, smooth, margin distinct. Ascomata not raised above thallus level, dark red-brown, round, 0.3–0.7 mm diam., about 50 μm high; epihymenium brown; hymenium and hypothecium pale brown. Asci 8-spored, short clavate; ascospores clavate, 2-septate, distal cell enlarged, not curved, with slight constrictions at septa, colorless, 12.5–15 × 3–5 μm (n = 120).

Chemistry—not tested.

Specimens examined: **CHINA**. **Hainan**, **Ledong Co.**, Jianfeng Ridge, Mingfeng Valley, 18°44′36″N 108°50′39″E, 960 m a.s.l., on leaves, 6 Sep. 2017, Wei C. Wang 139434, 139435 (HMAS-L); **Baoting Co.**, Qixian Ridge National Forest Park, 18°42′21″N 109°42′14″E, 350 m a.s.l., on leaves, 7 Sep. 2017, Wei C. Wang 139424, 139426 (HMAS-L); 500 m a.s.l., on leaves, 7 Sep. 2017, Wei C. Wang 139425 (HMAS-L); **Wuzhishan City**, Wuzhishan National Forest Park, 18°54′18″N 109°41′04″E, 800 m a.s.l., on leaves, 8 Sep. 2017, Wei C. Wang 139432 (HMAS-L).

Distribution—Kenya (Lücking & Kalb 2002), Vietnam (Nguyen & al. 2011), and China (Hainan).

Comments—*Arthonia accolens* is recognized by its shiny yellow-brown thallus, distinctly marginate red-brown ascomata, and 2-septate ascospores. The same ascospore type is found in *A. lividula*, which is distinguished by its light brown,

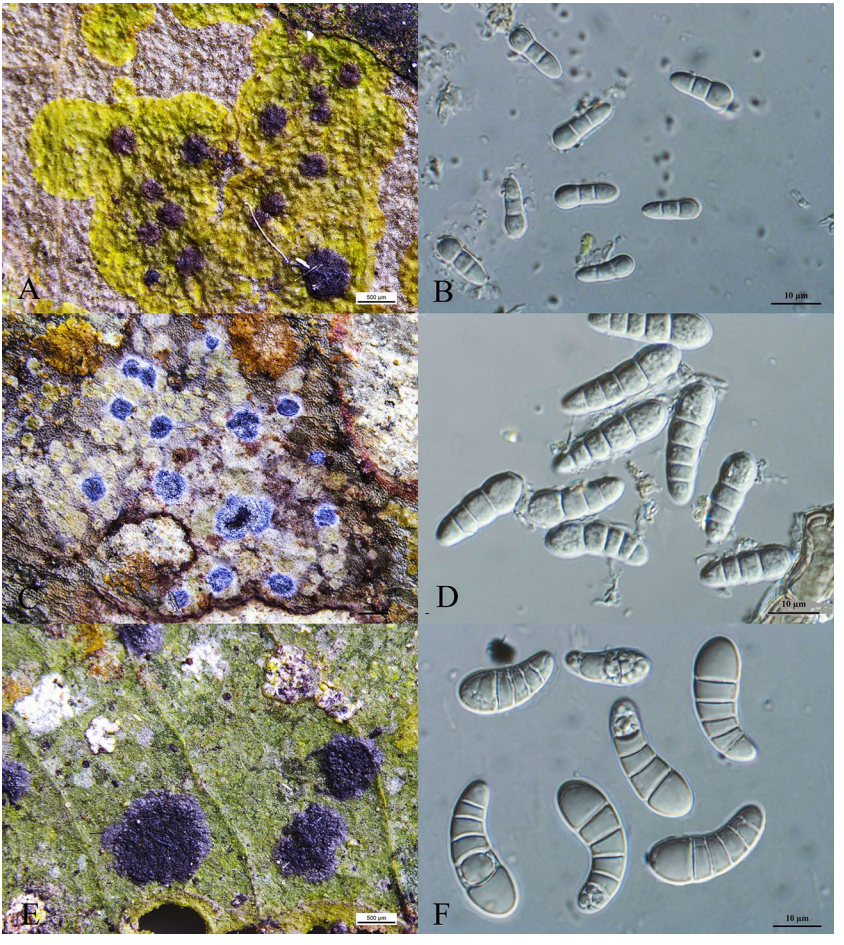

Fig. 1. Habitus and ascospores. A, B: ***Arthonia accolens*** (HMAS-L Wang 139432); C, D: ***Arthonia cyanea*** (HMAS-L Jiang & Guo 138619); E, F: ***Arthonia palmulacea*** (HMAS-L Wang 139415). Scale bars: A, C, E = 500 µm; B, D, F = 10 µm.

smaller ascomata (<0.5 mm diam.) with diffuse margins. *Arthonia accolens* is common in Hainan.

Arthonia cyanea Müll. Arg., Flora 64: 233 (1881) Fig. 1c, d

Thallus dispersed into small round patches, green-grey, thin, smooth. Ascomata not raised above thallus level, bluish grey, with white pruina, round or slightly irregular in outline, 0.4–1.0 mm diam., about 50 µm high;

epihymenium composed of pale yellow granules, with crystals; hymenium and hypothecium colorless. Asci 8-spored, short clavate; ascospores clavate, 3–4-septate, distal cell enlarged, with constrictions at septa, colorless, 17.5–25 × 5–7 μm (n = 120).

Chemistry—not tested.

Specimens examined: **CHINA**. **Hainan**, **Ledong Co.**, Jianfeng Ridge, 18°44′N 109°10′E, 900 m a.s.l., on leaves, 1–3 Apr. 1993, Yu M. Jiang & Shou Y. Guo 138607, 138619, 138620, 138609, 138610 (HMAS-L); on leaves, 2 Oct. 2008, B. Gao 126474 (HMAS-L); **Changjiang Co.**, Bawang Ridge, 19°15′N 109°02′E, 670 m a.s.l., on leaves, 20 May 2007, T. Zhang 126740 (HMAS-L); 19°16′N 109°03′E, on leaves, 22 Apr. 2000, Jiang C. Wei 112772 (HMAS-L).

Distribution—Rwanda (Bock & al. 2007), Tanzania (Farkas 2015), Kenya (Lücking & Kalb 2002), Congo (Van den Broeck & al. 2014), Madagascar (Aptroot 2016), New Zealand (Galloway 2007), Australia, India, Indonesia, Philippines (Santesson & Tibell 1988), Indonesia (Santesson & Tibell 1988), Thailand (Papong & al. 2007), Malaysia (Sipman 1993), and China (Hainan).

Comments—*Arthonia cyanea* is a widely distributed species, characterized by its patched thallus, bluish grey pruinose ascomata, and 2–4-septate clavate ascospores. Our Hainan specimens differ slightly from previous descriptions of *A. cyanea*, which do not report any 4-septate ascospores; but they are closer to typical *A. cyanea* than to its two segregate infraspecific taxa.

Arthonia palmulacea (Müll. Arg.) R. Sant.,
Symb. Bot. Upsal. 12(1): 87 (1952) Fig. 1e, f

Thallus dispersed into small round patches, green-grey, thin, smooth. Ascomata not raised above thallus level, black, without pruina, round, 0.3–1.0 mm diam., about 40 μm high; hymenium pale brown, hypothecium brown. Asci 8-spored, globose; ascospores clavate, 3–5-septate, distal cell enlarged, usually curved, without distinct constrictions at septa, colorless, 16–28 × 8 μm (n = 80).

Chemistry—not tested.

Specimen examined: **CHINA**. **Hainan**, **Wuzhishan City**, Mt. Wuzhishan, tropical rain forest scenic spot, 18°51′59″N 109°40′30″E, 600 m a.s.l., on leaves, 9 Sep. 2017, Wei C. Wang 139415 (HMAS-L).

Distribution—Congo (Van den Broeck & al. 2014) and China (Hainan).

Comments—*Arthonia palmulacea* is easily recognized by its black ascomata and 3–5-septate curved ascospores lacking septal constrictions.

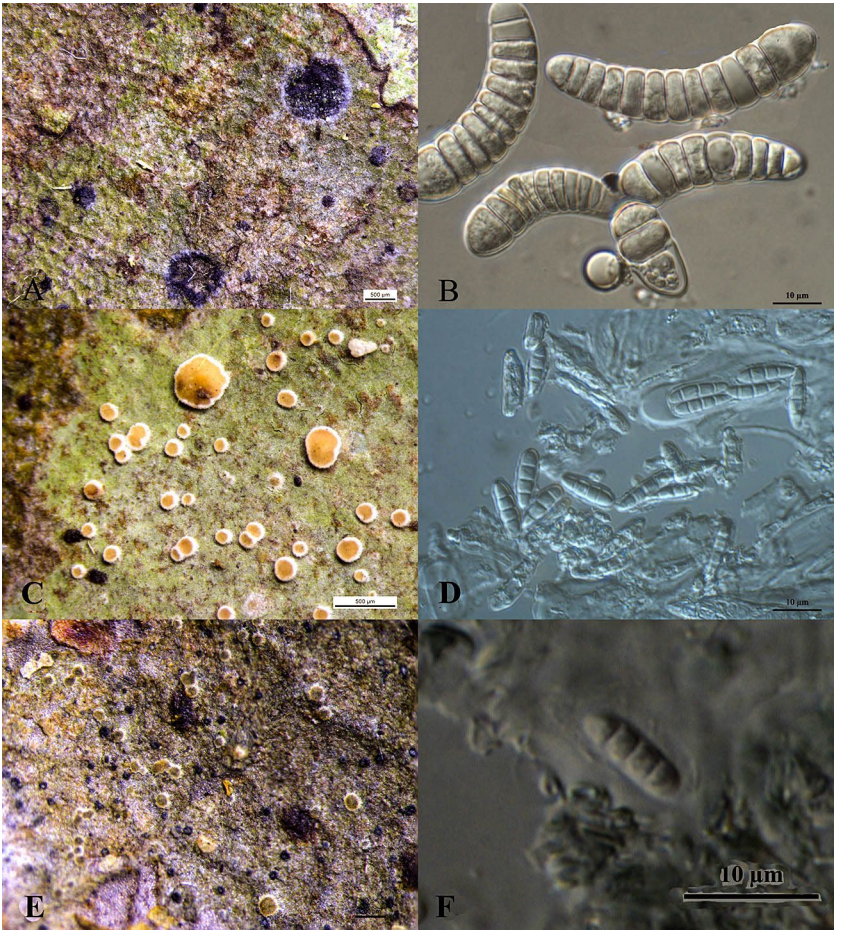

Fig. 2. Habitus and ascospores. A, B: ***Eremothecella macrosperma*** (HMAS-L Wang 139408); C, D: ***Byssoloma annuum*** (HMAS-L Wang 139408); E, F: ***Byssoloma subleucoblepharum*** (HMAS Gao 126449). Scale bars: A, C = 500 µm; B, D, F = 10 µm; E = 200 µm.

Eremothecella macrosperma (Zahlbr.) Sérus,
Syst. Ascom. 11: 43 (1992) Fig. 2A, B

Thallus smooth, greyish green. Photobiont cells orange, bead-like, about 12.5 µm diam. Ascomata black, <1 mm diam. and 120 µm high. Epihymenium, hymenium and hypothecium are all colorless or (at most) pale brown. Asci 8-spored; ascospores clavate, large, 7–11-septate, usually curved, distal cell enlarged, with constrictions at septa, colorless, 35–60 × 10 µm (n = 60).

Chemistry—not tested.

Specimen examined: **CHINA**. **Hainan**, **Wuzhishan City**, Wuzhishan National Forest Park, 18°54′18″N 109°41′04″E, 800 m a.s.l., on leaves, 8 Sep. 2017, Wei C. Wang 139408 (HMAS-L).

Distribution—Indonesia (Sérusiaux 1992) and China (Hainan).

Comments—*Eremothecella macrosperma* is easily confused with *Arthonia palmulacea* due to their similar thallus and apothecia, but *E. macrosperma* has much larger ascospores with more numerous septa.

Pilocarpaceae Zahlbr.

Byssoloma annuum (Vain.) G. Thor, Lücking & Tat. Matsumoto, Symb. Bot. Upsal. 32(3): 29 (2000) Fig. 2c, d

= *Byssoloma dimerelloides* Sipman & Aptroot, Willdenowia 20: 240 (1991) [fide Thor & al. 2000]

= *Byssoloma clauzadei* Kalb & Vězda, Bull. Soc. Linn. Provence 45: 236 (1994) [fide Thor & al. 2000]

Thallus continuous, smooth, greyish green. Apothecia pale yellowish brown, 0.3–0.6 mm diam, slightly constricted at the base, disc flat to convex, margin white, compact; excipulum inner part pale yellow, outer part colorless, composed of loosely hyphae, containing crystals; epihymenium indistinct; hymenium colorless, 50–60 μm tall; hypothecium pale yellow, containing crystals; apothecial base colorless. Asci 8-spored; ascospores colorless, ellipsoid, 3-septate, without septal constrictions, 12–15 × 3 μm (n = 120).

Chemistry—not tested.

Specimens examined: **CHINA**. **Hainan**, **Ledong Co.**, Jianfeng Ridge, 18°44′N 109°10′E, 1000 m a.s.l., on leaves, 10 Sep. 2000, Man R. Huang 112833 (HMAS-L); 18°44′48″N 109°10′22″E, 900 m a.s.l., on leaves, 3 Apr. 1993, Yu M. Jiang & Shou Y. Guo 138621 (HMAS-L); **Changjiang Co.**, Bawang Ridge, 19°15′31″N 109°02′54″E, 670 m a.s.l., on leaves, 20 May 2007, T. Zhang 126588, 126728, 126597, 126603 (HMAS-L); **Wuzhishan City**, Mt. Wuzhishan, 18°53′N 109°41′E, 900 m a.s.l., on leaves, 20 Apr. 2000, Jiang C. Wei 112938, 112809, 112823 (HMAS-L); 18°54′18″N 109°41′04″E, 800 m a.s.l., on leaves, 8 Sep. 2017, Wei C. Wang 139408 (HMAS-L).

Distribution—Australia, Japan (Thor & al. 2000), Thailand (Papong & al. 2007), Philippines, Papua New Guinea (Aptroot & Sipman 1991), and China (Hainan).

Comments—*Byssoloma annuum* is common in Asian tropical rainforests and has been reported several times in Asia. Its pale yellow apothecia easily distinguish it from other species. *Byssoloma carneum* and *B. sprucei* are closely related to it, but both have 3-septate ascospores, compact margins, and exciples with crystals; additionally, *B. sprucei* differs by its reddish brown apothecia, orange brown hypothecium, and brown apothecial base, and *B. carneum* differs

by farinose thallus dispersed into irregular patches, flat to slightly concave apothecia, and yellowish brown hypothecium (Lücking 2008).

Byssoloma subleucoblepharum G. Thor, Lücking & Tat. Matsumoto, Symb. Bot. Upsal. 32(3): 31 (2000) Fig. 2e, f

Thallus thin, smooth, grey-green; prothallus not seen. Apothecia small, about 0.1 mm diam., rounded, grey-green, similar to the color of thallus, slightly convex, margin byssoid, composed of loose grey-white hyphae; epihymenium indistinct; hymenium colorless; apothecial base aeruginous. Asci 8-spored; ascospores 3-septate, ellipsoid, colorless, 8–10 × 2.5 µm (n = 80).

Chemistry—not tested.

Specimens examined: **CHINA**. **Hainan**, **Changjiang Co.**, Bawang Ridge, 19°15′31″N 109°02′54″E, 700 m a.s.l., on leaves, 5 Oct. 2008, B. Gao 126436, 126449 (HMAS-L).

Distribution—Japan (Thor & al. 2000) and China (Hainan).

Comments—*Byssoloma subleucoblepharum* is small and hard to find. It is characterized by its small greyish green apothecia, aeruginous apothecial base, which distinguishes it from all other known *Byssoloma* species.

Gomphillaceae Walt. Watson

Calenia lueckingii C. Hartmann, Mycotaxon 59: 484 (1996) Fig. 3a, b

Thallus continuous, verrucose, green. Apothecia immersed-erumpent, pale green, 0.3–0.5 mm diam., disc smooth, slightly concave; epihymenium with epithecial algae; hymenium and hypothecium colorless. Asci 1-spored; ascospores colorless, ellipsoid, muriform, large, 40–55 × 20 µm (n = 60).

Chemistry—not tested.

Specimens examined: **CHINA**. **Hainan**, **Changjiang Co.**, Bawang Ridge, Baishitan scenic spot, 19°07′07″N 109°09′12″E, 700 m a.s.l., on leaves, 4 Sep. 2017, Wei C. Wang 139419, 139417 (HMAS-L); **Wuzhishan City**, Wuzhishan National Forest Park, 18°54′18″N 109°41′04″E, 800 m a.s.l., on leaves, 8 Sep. 2017, Wei C. Wang 139427, 139409, 139431, 139430, 139410, 139429, 139411, 139428 (HMAS-L); Mt. Wuzhishan, tropical rain forest scenic spot, 18°51′59″N 109°40′30″E, 600 m a.s.l., on leaves, 9 Sep. 2017, Wei C. Wang 139414, 139413 (HMAS-L).

Distribution—Neotropics (Lücking 2008) and China (Hainan; the first record from the paleotropics).

Comments—Species of *Calenia* are not abundant on Hainan, with the exception of *C. lueckingii*, which is recognized by its pale green apothecia with epithecial algae, in addition to the pale green, verrucose thallus, and the single, large, muriform ascospores. Most similar are *Gyalectidium* species, which differ by their much smaller apothecia, often with a split between excipulum and thallus margin.

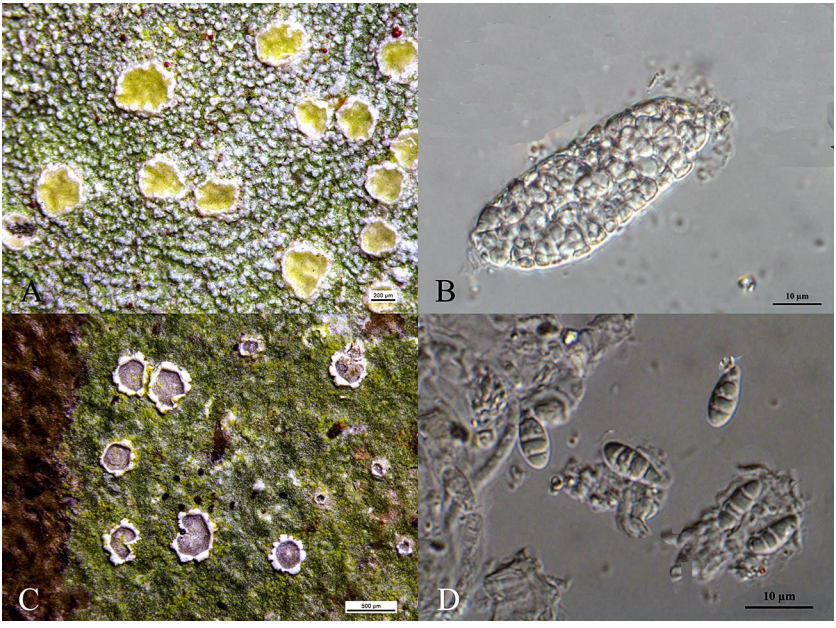

Fig. 3. Habitus and ascospores. A, B: ***Calenia lueckingii*** (HMAS-L Wang 139414); C, D: ***Chroodiscus argillaceus*** (HMAS-L Wang 139433). Scale bars: A = 200 µm; B, D = 10 µm; C = 500 µm.

Graphidaceae Dumort.

Chroodiscus argillaceus (Müll. Arg.) Lücking & Papong, Bryologist 112: 154 (2009) Fig. 3c, d

Thallus continuous, greyish green, sometimes covered with yellow granules. Apothecia immersed-erumpent, disc flat, dark grey, 0.2–0.5 mm diam.; epihymenium indistinct; hymenium colorless, about 35 µm tall, consisted of parallel hyphae; hypothecium poorly developed, almost absent. Asci 8-spored; ascospores colorless, ellipsoid, 3-septate, 6–10 × 3 µm (n = 60).

Chemistry—not tested.

Specimens examined: **CHINA**. **Hainan**, **Ledong Co.**, Jianfeng Ridge, Mingfeng Valley, 18°44′36″N 108°50′39″E, 960 m a.s.l., on leaves, 6 Sep. 2017, Wei C. Wang 139422, 139433, 139421 (HMAS-L); **Wuzhishan City**, Wuzhishan National Forest Park, 18°54′18″N 109°41′04″E, 800 m a.s.l., on leaves, 8 Sep. 2017, Wei C. Wang 139412 (HMAS-L).

Distribution—Thailand (Papong & al. 2007) and China (Hainan).

Comments—*Chroodiscus* has been studied in Southeast Asia by Papong & al. (2009). *Chroodiscus khaolungensis* resembles *C. argillaceus* due to 3-septate ascospores but differs in having longer (18–24 µm) ascospores.

Coenogoniaceae Stizenb.

Coenogonium minimum (Müll. Arg.) Lücking,
Fl. Neotrop. Monogr. 103: 572 (2008) Fig. 4a, b

Thallus continuous, smooth, greyish green. Apothecia brown, 0.1–0.2 mm diam., disc strongly concave, margin persistent; excipulum well developed, colorless, paraplectenchymatous; epihymenium, hymenium and hypothecium colorless. Asci 8-spored; ascospores colorless, ellipsoid, 1-septate, 10–14 × 3 μm (n = 120).

Chemistry—not tested.

Specimen examined: **CHINA**. **Guangxi**, **Shangsi Co.**, Shiwandashan Forest Park, 21°53′08″N 107°54′41″E, 657 m a.s.l., on leaves, 25 May 2015, Xin L. Wei & Jiao H. Wang 133031 (HMAS-L).

Distribution—Neotropics (Lücking 2008), Vietnam (Nguyen & al. 2011), and China (Guangxi).

Comments—*Coenogonium minimum* is characterized by its small brown apothecia with strongly concave discs. *Coenogonium lisowskii* and *C. dilucidum* are closely related to *C. minimum* in both having small apothecia, but

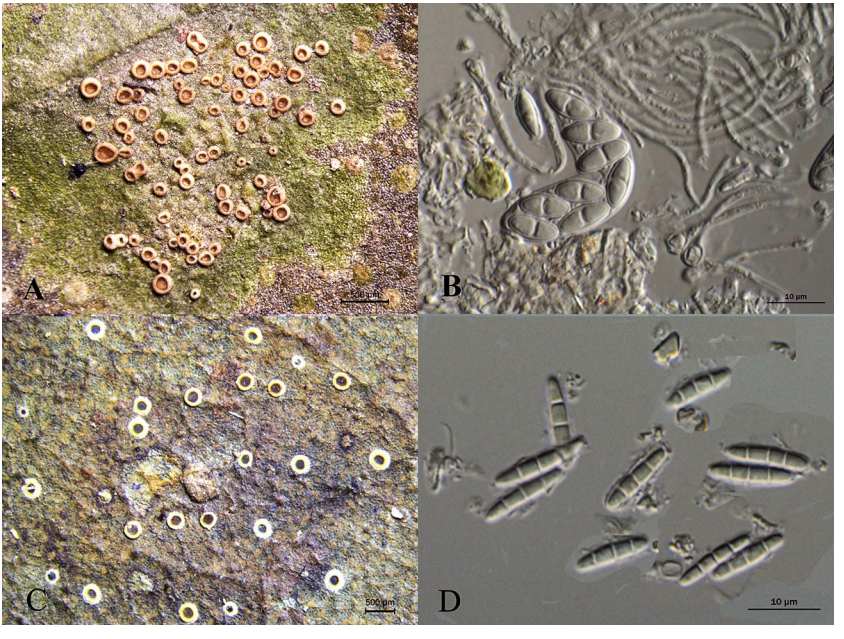

Fig. 4. Habitus and ascospores. A, B: ***Coenogonium minimum*** (HMAS-L Wei & Wang 133031); C, D: ***Semigyalecta paradoxa*** (HMAS-L Jiang & Guo 138622). Scale bars: A, C = 500 μm; B, D = 10 μm.

C. lisowskii has wax-colored to yellow-brown apothecia and smaller ascospores, and *C. dilucidum* has wax-colored to pale yellow apothecia (Lücking 2008).

Gyalectaceae Stizenb.

Semigyalecta paradoxa Vain.,
Ann. Acad. Sci. Fenn., Ser. A 15(6): 153 (1921) Fig. 4c, d

Thallus continuous, smooth, greyish brown; prothallus black along the margin. Apothecia sessile, round, 0.2–0.4 mm diam., <80 μm high, slightly constricted at the base, disc flat, dark brown, margin well developed, smooth, white when young, turning yellow when mature. Excipulum well developed, colorless with pale yellow tinge, containing crystals; epihymenium indistinct; hymenium colorless, about 35 μm tall; hypothecium dark brown. Asci 8-spored; ascospores fusiform, 3-septate, colorless, 10–15 × 2.5 μm (n = 60).

Chemistry—not tested.

Specimens examined: **CHINA**. **Hainan**, **Ledong Co.**, Jianfeng Ridge, 18°44′N 109°10′E, 900 m a.s.l., on leaves, 3 Apr. 1993, Yu M. Jiang & Shou Y. Guo 138608, 138622, 138625, 138640 (HMAS-L).

Distribution—Japan (Thor & al. 2000), Philippines, Malesia (Santesson 1952), and China (Hainan).

Comments—The monotypic genus *Semigyalecta* established by Vainio in 1921 was included in *Gyalectaceae,* but Santesson (1952) questioned this family placement. The genus is controversial, because its photobiont is difficult to identify; Kalb (1994) considered *Semigyalecta* to be a non-lichenized fungus, and Lücking did not reach a definite conclusion after studying the specimens from Japan (Thor & al. 2000). Our Hainan specimens had a photobiont in the thallus. The genus is obviously in need of further research to determine its appropriate classification status.

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